OPTOGENETICS FOR INTRACELLULAR CODEBREAKING: HOW ERK DYNAMICS CONTROL GENE EXPRESSION AND CELL FATE

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Every cell exists in a complex and changing environment. To deal with their complex surroundings, cells have evolved diverse systems to sense external cues and create an internal representation of this information. However, we are still largely in the dark about how external information is stored in patterns of protein activity, and how this information is decoded into specific cell fate decisions. I will talk about our efforts to overcome these challenges using cellular optogenetics: the delivery of precise spatial and temporal activity patterns to a signaling protein of interest. We have developed a suite of optogenetic tools to precisely control MAP kinase (MAPK) signaling. Combining optogenetics and live-cell biosensors enables us to dissect how signaling dynamics are "read out" into target mRNA and protein levels. Applying these tools in the Drosophila embryo further revealed how a model cell fate choice - differentiation into posterior midgut endoderm - is controlled by specific patterns of MAPK activity.